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ABSTRACT

A survey of 498 elementary and secondary teachers was coordinated by the National Engineering Consortium (NEC) in order to determine what educational technologies are used and valued by teachers and what they need to help make educational technology a more valuable resource. The questionnaire included two closed-end questions rating 36 technologies (and inviting commentary) as well as four open-end questions. Specific questions addressed teachers' use and value of old versus emerging technologies; what they considered to be the most and the least promising educational technology tools; their use of technology according to subject areas; and aid that they felt could be provided by computer companies and corporations. The most highly used technologies were found to be microcomputers, overhead projectors, videocassette recorders, software teaching aids, and movie/slide projection systems. Emerging technologies include multimedia computer projection systems, computer networks, videodisks, telecommunications, and software to aid problem solving. Current technologies considered promising for continued usage are microcomputers, video recorders, and overhead projectors, including computer-driven projectors. Respondents stated that their greatest need was funding, followed by training and support for educational technology products. Teachers also responded that more time is required for planning, implementing, training, and studying technology. A copy of the questionnaire used in the study is appended. (DB)

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Educational Technology in the Kindergarten through Twelfth Grades

August 1990

A Study of Usage, Value and Needs

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Sponsored by the National Engineering Consortium

Educational Technology
in
Kindergarten through Twelfth Grades

A Study of Usage, Value and Needs

August 1990

Robert M. Janowiak

Sponsored by the
National Engineering Consortium

Educational Technology
in
Kindergarten through Twelfth Grades

A National Engineering Consortium Research Study of the perceived value and usage of educational technology by K-12 grade teachers. Perceived needs to help make educational technology a more valuable resource are also covered.

Educational Technology
from
Kindergarten through Twelfth Grades

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Introduction and Summary

This study was recommended by the National Engineering Consortium's Executive Advisory Councils whose membership includes over 100 executives from leading information industry corporations.

In reviewing educational technology (ET) products and usage, it became clear there is little national concensus on what is effective both today and in the future.

This study focused on asking teachers what they used and valued, as well as what teachers need to help make ET a more valuable resource.

Nearly 500 teachers responded to a questionnaire covering two closed-end questions rating 36 technologies and four open-end questions. This report summarizes the statistics and typical teacher responses.

Today's most highly used educational technologies are microcomputers, overhead projectors, video cassette recorders, software teaching aids, and movie/slide projection systems.

Emerging technologies include multimedia computer projection systems, computer networks, video disks, telecommunications and software to aid problem solving. Current technologies considered promising for continued usage are microcomputers, video recorders and overhead projectors – including computer-driven.

Integrating these products enable interactive multimedia – video, data, sound systems – that provide educational resources on demand.

By far the largest need the teachers expressed was financial. They simply do not have the budgets to purchase and support educational technology tools they perceive as valuable.

Next, teachers are requesting training and support of lead school technology coordinators, current and future teachers.

Teachers want better products that are effective and easy to use. Teachers also responded that more time is needed for self training, planning, implementing, studying technology and teacher training.

Information industry actions which should help accelerate ET usage:

- Define ET Models Needed – Define model resources of educational technologies needed as well as operational support and resources.
- Sell ET Value – Companies should help schools sell the needed ET to public and governmental bodies.
- Support ET – A larger commitment to support schools and educators must be established, perhaps cooperatively with other companies and universities.
- Build Infrastructure – In addition to supporting the present educational system, companies can encourage education about ET at teacher colleges.
- Develop Products – Develop effective products offering excellent value. Products must include the device and everything required to make the product effectively used in the classroom.
- Get Teacher Input – Listen to and use teacher input for product development.
- Evolve Technology – Make future systems evolve and use the current embedded base.
- Commit to Success – Zealously commit to insure that ET is integrated into the fabric of the school system. It must be used as easily as textbooks, notepads and pencils.

This study was underwritten by the National Engineering Consortium in the hope that it will catalyze the necessary commitment to make educational technology improve the learning environment of all students. The 46 year old nonprofit National Engineering Consortium is affiliated with 51 major high technology universities. Through a variety of service programs the Consortium encourages student development, administers industry-university programs, and educates industry professionals and university professors.

State of Education in the United States

There are substantial problems with K-12 education in the United States. Dropout rates are high. Educational quality in many schools is mediocre. An average student in an average school is poorly prepared compared to his/her counterpart in other developed countries.

Undereducated students have an extremely negative impact on society. Unable to succeed in college or trades, they are often caught in a web of unemployment.

Employers must deal with the stark reality of this poorly educated young work force. The Ad Hoc Committee on Education of the Business Roundtable reports that 60 percent of high school graduates are not prepared for entry-level jobs. *Training* magazine recently reported that 30 percent of larger American companies offer remedial education.

Most businesses require reading, writing and mathematics skills. For the United States to be competitive, our educational system must provide human resources superior to other countries.

President Bush has outlined broad initiatives to improve U.S. education. Technology can be an important factor in meeting improved educational goals.

Need for Mathematics and Science Literacy

The Information Age requires a literate work force, especially in mathematics and science. Desktop terminals are finding increasing applications. Corporations dedicated to quality need employees capable of understanding mathematics and scientific/engineering principles.

Motorola, winner of the Malcolm Baldrige National Quality Award, has established an in-house university for remedial and continuing education.

The 21st century promises even greater use of home computers and terminals. Computers will be utilized by the U.S. population to accomplish daily tasks and fulfill needs such as shopping, banking, education and entertainment.

Supporting the Information Age will require an increasing number of analysts, programmers, computer/telecommunication engineers, technicians and applications specialists. All must be effectively educated in our K-12 system. Unfortunately, U.S. student achievement is very low compared to other developed countries. International test results in mathematics, chemistry, physics and biology rank U.S. students near the bottom of all participating countries.

Although we have some magnet schools specializing in mathematics and sciences, student enrollment falls far short of future infrastructure needs. Our top public and private schools have good programs, but many of our best students are not attracted to science and engineering. Law, accounting and finance are professions of greater interest to many of our brightest students.

We must improve both motivation and education in mathematics and science if the U.S. is to be globally competitive in the 21st century.

A Look at Japan

Japanese students study far more mathematics and science than U.S. students. Their educational program is typically 240 days per year compared with 190 in the United States.

Studies also show that Japanese mathematics and science curricula cover more ground and are more demanding.

By the end of ninth grade, all Japanese students have taken elementary geometry, trigonometry, algebra and probability and statistics. In science, courses include biology, chemistry, physics, and earth science.

Attendance in grades 10-11-12 is voluntary and competitive. Lower secondary school records and tests determine which students will enter the better upper secondary schools. Many students attend private tutoring programs to improve their chances. About 90 percent of the students attend the upper schools, which charge tuition.

Within the upper secondary schools, students select a course of study which is usually fixed with few or no electives. Those planning science and engineering majors take mathematics through differential and integral calculus plus physics, chemistry and biology. Students take 18 out of 34 hours per week in mathematics and science courses.

The net effect is that a larger percentage of Japanese college graduates major in natural science and engineering than in the United States.

More importantly, research data indicates that there is less variation among students in mathematics and science learning than in the U.S. The Japanese assume that everyone can and must be competent in these subjects. Poor performance in mathematics is considered to be a lack of effort.

The Promise of Technology

Computers and telecommunications are well suited for education. Vast amounts of educational information are available together with tools to select and manipulate specific subjects.

Software can be programmed to adapt learning to each student's needs, providing corrective advice and allowing students to progress at their own pace. Teachers will guide and manage learning.

Computing power is available at decreasing cost. The cost of a workstation will soon be a fraction of the annual cost of a student's education.

Telecommunications opens the classroom to the world. Information can be obtained from a variety of sources. Students can communicate with others around the world. Projects involving hundreds or thousands of schools are possible.

Remote learning offers students complete courses in subjects not available in their schools. Enrichment course materials are an option.

The future will provide multimedia environments where students will experience text, graphics, sound and video. This integration and effective presentation of information will afford learning experiences beyond anything existing today.

The federal government has a variety of initiatives. The National Science Foundation (NSF) has the following goal:

> The NSF's own programs at the elementary and secondary levels should give high priority to expanded use of new technologies in the classroom, to developing improved science and math curricula and materials, to training teachers of science and math, and to research and experimentation on learning of math and science.

Specific areas of emphasis include:

- Training for teachers, both in the substance of subjects they teach and in effective use of the new materials and technologies.
- Improved curricula and materials, particularly ones that take advantage of new technologies and make them educationally effective and ones that give children "hands on" experience with science.
- Expanded use of computers, interactive video, and other new technologies in the classroom.

Technology as a Teaching Partner

The use of computers and telecommunications offers opportunities to better learn mathematics and science as well as other subjects. Although computers have been in some classrooms for 20 years, teacher and student usage is still quite limited. Except for television, telecommunications is even more recent.

The Consortium's survey (beginning on page 6), sought to determine educational usage and value of a wide range of technologies. The following descriptions are presented to set the stage.

Audio Tapes

Supplementary audio resources for students are available, especially for use in foreign languages. Other courseware and resource materials are available.

Cable Television

Quality educational programs may be distributed to schools by cable networks. Video tapes permit discretionary use. Copyright issues for commercial material must be addressed.

Computer-Assisted Instruction

This software helps students learn a subject by providing explanation, drills and tests. A wide range of subjects have computer-assisted instruction. Some software is used to help students learn about computers and programming.

Computer-Managed Instruction

This class of software aids teachers by monitoring student progress, maintaining records and helping with other administrative and classroom management tasks.

Courseware

This computer software augments a specific course. Courseware applications include helping students accomplish an academic task in writing, analyzing data or solving problems.

Desktop Publishing

Software provides documentation and formatting of publications. It can be used by students and teachers for newsletters, reports and other applications.

Distance Learning

By establishing video networks, schools can receive courses from a remote school. This permits sharing resources so all schools are not required to have teachers in specialized, advanced subjects. Some systems have audio phone connection for student questions. More advanced systems use two-way video and large screen monitors.

Interactive Laser – Video Disk

Larger data bases such as encyclopedias and multimedia courseware (data, sound, video) are available on demand using laser disk readers and microcomputers. With hypercard technology, information can be organized and presented in multimedia formats.

Multimedia Systems

Large monitors and projection television provide theatre-like viewing. Interactive data bases enable students to view videos of geographical locations, historical events and other resources. A class can view data output in real time on computer-driven overhead projectors. Advanced sound systems enhance communication of course material.

Networked Microcomputers

In the last five years, local area networking of microcomputers has become commonplace. Although not yet extensively used in schools, networking offers opportunities for students and teachers to interact electronically.

Projection Systems

Slides and motion pictures provide resource materials to supplement classroom education.

Software to Aid Problem Solving

This category includes programs designed to provide special problem-solving insights and practice.

Stand-alone Microcomputers

The microcomputer, first used in the early 1970s, is an affordable tool for students. Schools deploy groups of microcomputers in learning centers, libraries and some classrooms. Early software provided learning drills and other training programs. Present direction is simulation of science experiments, mathematics problems and other courses. Because of the small number of computers per student (range 1:10 to 1:17), computers are commonly used as enrichment rather than an integral part of teaching.

Telecommunications – Computers

Telecommunications enables students to electronically communicate with other students anywhere in the world. Students can also access data bases of information. The National Geographic Society's Kids Network links elementary school students around the United States in scientific experiments. Electronic bulletin boards allow students to exchange messages.

Television

Television broadcasts, often from the Public Broadcasting System, are used in classrooms in "real time." Teachers schedule classes so television programs can be shown when transmitted.

Television – Satellite

Live video can be simultaneously transmitted from satellites to schools throughout the United States, making excellent resource and course material available. A negative aspect is the inability to video back, thus precluding spontaneous questions and dialog. Channel One offers schools three channels including a 12 minute news broadcast with two minutes of commercials. Satellite dishes, VCRs and televisions are provided free to schools.

Test Correction Services

To aid teachers, specially formatted tests are taken by students, and answers are read by scanners and scored.

Video Recorders

Programs transmitted to schools may be archived using video recorders. Video tapes covering courseware and resource materials are also available for classroom use.

Voice Messaging

Voice messaging equipment permits teachers to communicate to parents regarding learning progress, homework assignments and other school issues.

National Engineering Consortium Teacher Survey

The Consortium surveyed teachers on the usage and value of educational technology. Respondents' ideas were also sought on making educational technology a more valuable resource.

A four-page questionnaire (see Appendix) was developed, consisting of six questions, four of which were open-end. The two closed-end questions contained 36 items to be rated with open-end comments also solicited. A cover letter accompanied the questionnaire.

A total of 3,556 questionnaires were mailed and 498 (14%) were returned. The quality of responses was generally very good, with thoughtful answers to open-end questions. Teachers subscribing to *The Computing Teacher* magazine were surveyed since a reasonably sophisticated respondent in computers/technology was the survey goal.

Of the respondents, 51 percent were learning coordinator/librarian/teacher and 31 percent were full-time teachers. The remainder had a variety of other titles.

K-12 school respondent distribution was as follows: Elementary (grades 1-6) – 31%, Junior High School (grades 7-9) – 19%, Senior High School (grades 9-12) – 50%; Public – 88%, Nonpublic – 12%. The average school enrollment was 967 students.

Educational Technology Usage

Teachers were asked to rate usage of 24 technology tools on a four point scale. Table 1 (page 7) presents the average weighted usage rating that spanned 1.09 to 3.77.

Microcomputers were rated most highly, followed by overhead projectors, video cassette recorders and courseware. It is interesting to note that courseware was reported to be the most used software, rated nearly 0.5 higher than software to aid problem solving and computer-assisted instruction.

Over the past five years video cassette recorders have become widely deployed in schools. Offering educational tapes and taping capability, a video program may be shown when the teacher needs the educational resource.

Projection systems provide movies and slide-based resources. This older technology has substantial educational materials available but has a number of disadvantages including the need for a darkened classroom.

Educational Technology Tools – Usage

Table 1

	Usage Avg.
Micro/personal computers	3.77
Overhead projector	3.48
Video cassette recorder	3.36
Courseware, e.g. math, science, English	2.99
Projection systems (movies, slides)	2.81
Television/cable TV	2.63
Desktop publishing	2.54
Software to aid problem solving	2.53
CAI - Computer-Assisted Instruction	2.49
Test correction scanners	2.24
Audio tapes or compact disks	2.14
Computer networks	2.13
Off-site information services	1.93
CMI - Computer-Managed Instruction	1.90
Telecommunications	1.80
CAD - Computer-Aided Design	1.78
Multimedia computer projection systems	1.78
Mini/large computers	1.76
Integrated learning systems	1.57
Video disk/compact disks (interactive)	1.44
Robots	1.34
Remote distance learning	1.25
Voice messaging	1.11
Voice recognition unit	1.09

4 - used a great deal

3 - used often

2 - seldom used

1 - not used

Educational Technology Value

For each of the 24 tools, teachers were asked to rate value. The tools were rated from 1.73 to 3.86 as shown in Table 2 (page 9).

It is interesting that 14 tools were rated "valuable" (3.0) or greater. The top four technologies in usage were also ranked highest in value in the same order.

Microcomputers
Overhead Projector
Video Recorder
Courseware

Other software rated "valuable" includes desktop publishing, software to aid problem solving, computer-assisted instruction and test correction services.

An interesting set of technologies were also rated "valuable":

Computer Networks
Multimedia Computer Projection Systems
Television/Cable TV
Telecommunications
Off-Site Information Services
Video Disk/Compact Disks

Educational Technology Tools – Value

Table 2

	Value Avg.
Micro/personal computers	3.86
Overhead projector	3.62
Video cassette recorder	3.50
Courseware, e.g. math, science, English	3.36
Desktop publishing	3.35
Software to aid problem solving	3.29
Computer networks	3.21
Multimedia computer projection systems	3.21
CAI - Computer-Assisted Instruction	3.09
Television/cable TV	3.08
Telecommunications	3.03
Test correction scanners	3.01
Off-site information services	3.00
Video disk/compact disks (interactive)	2.98
CAD - Computer-Aided Design	2.84
Projection systems (movies, slides)	2.81
Audio tapes or compact disks	2.73
CMI - Computer-Managed Instruction	2.72
Mini/large computers	2.65
Integrated learning systems	2.65
Remote distance learning	2.39
Robots	2.30
Voice messaging	1.73
Voice recognition unit	1.73

4 - extremely valuable

3 - valuable

2 - slightly valuable

1 - not valuable

Technology Changes

By comparing usage and value rankings, technologies can be identified as declining and emerging. Study results identify significant trends.

Table 3 (page 11) presents usage to value ranking ratio data on technologies. Declining technologies are identified as those having relatively low ratios.

For example, if a technology is ranked tenth in usage and fifth in value, the ratio is 2.0; or a ranking of third in usage and tenth in value results in a 0.3 ratio. The following are judged in a state of decline by respondents.

Projection Systems
Television/Cable TV
Audio Tapes

Emerging technologies are used less but rated high value. The following are viewed by respondents as having value rankings substantially higher than usage rankings:

Multimedia Computer Projection Systems
Computer Networks
Video disk/Compact disks
Desktop Publishing
Telecommunications

Educational Technology Tools – Technology Changes

Table 3

	Usage/Value Ratio Rank
Multimedia computer projection systems	2.29
Computer networks	1.71
Video disk/compact disks (interactive)	1.43
Desktop publishing	1.40
Telecommunications	1.36
Software to aid problem solving	1.33
CAD - Computer-Aided Design	1.07
Remote distance learning	1.05
Voice recognition unit	1.04
Micro/personal computers	1.00
Overhead projector	1.00
Video cassette recorder	1.00
Courseware, e.g. math, science, English	1.00
CAI - Computer-Assisted Instruction	1.00
Off-site information services	1.00
Integrated learning systems	1.00
Voice messaging	1.00
Mini/large computers	0.95
Robots	0.95
Test correction scanners	0.83
CMI - Computer-Managed Instruction	0.78
Audio tapes or compact disks	0.65
Television/cable TV	0.60
Projection systems (movies, slides)	0.31

Most Promising Educational Tools

To the second question asked, "...which (educational technology tools) do you consider the MOST promising for continued usage?", answers were thoughtful, with many respondents listing several educational technology tools. Table 4 (page 13) summarizes the percent of total respondents who listed each technology tool.

- Micro/Personal Computers were listed by half of the survey respondents. There was considerable enthusiasm for computer use in a variety of educational settings. Some comments from teachers about microcomputers:

  "Microcomputers – especially when used with other technologies, i.e. video disk, compact disk, audio."

  "Computer networking and computer use with an overhead projector have greatest potential for math education."

  "Microcomputers – the more they get infused in classes, the more they will be used as tools to enhance education."

  "Microcomputers – writing, production of school paper, also laser disk – interactive video will grow."

  "Computer – video – telecommunications; students can access and control their own learning."

  "Microcomputers simulate independent hands-on learning, group discussion, illustrations in lecturing and cooperative learning."

  "Computer – anything from video disk to CD ROM because it brings information to the students' fingertips immediately."

  "Microcomputers and networks – the most applicable to our classes for exchanging information quickly."

  "Computers – mainly for drill and learning skills in a short period of time."

  "Microcomputers as an all-purpose tool to enhance delivery of instruction in all subjects."

  "Microcomputers – they lighten a teacher's work load."

  "Computers and networking – students are excited by their use and motivation is a large factor."

  "Microcomputers are most promising for continued usage as a tool for writing and creativity."

  "Microcomputers can help students in all subject areas and help develop problem solving."

  "Classroom computers and software for students to supplement and enrich coursework."

  "Microcomputers – most high school graduates need to know how to use them and how they are used in the job market."

  "Computers are the wave of the future."

Most Promising Educational Tools for Continued Usage

Table 4

	Percent of Respondents
Micro/Personal Computers	50
Video Disk/Compact Disk	26
Video Cassette Recorder	18
Telecommunications	11
Overhead Projectors	9
Computer Networks	7
Television/Cable TV	6
Computer-Assisted Instruction	6
Desktop Publishing	6
Multimedia Computer Projection Systems	5
Others rated less than 2%	

Interesting observations centered around breadth of usage, applications and interrelation with other technologies.

Teachers encouraged usage in mathematics, English, writing and other courses, with suggested improvement seen in development of learning, problem solving, and creativity skills.

Many teachers describe linking the computer to interactive video disks and networks to enrich the information available. Also, teachers consider computer output on large monitors, projections on viewgraphs, and multimedia as important.

- Video Disk Technology scored a strong second in teachers' ranking of most promising technologies. This is an important result since video disk technology usage was rated at only 1.44 compared with 3.77 for microcomputers. Specific comments by teachers:

  "Once it's widely linked to computers (interaction video) its power will be awesome."

  "Personal computers, laser disk player, VCR . . . they can be managed with the use of a personal computer."

  "VCR & interactive video disk. Flexible, integrated media."

  "Video disks have great possibilities, but not in small schools with limited budgets."

  "CD ROM & interactive multimedia – increases student access to information. Stimulates their research skills."

  "Interactive video disk allows for individual learning with little teacher direction."

  "Interactive disks allow students to progress at their own pace."

  "Interactive video – this by far outshines slides and is more up-to-date."

  "Interactive video – students love and are receptive to the medium. Well designed features."

  "Interactive video – will bring the world to students and teachers."

  "Interactive video and computers – very visual and controlled. Most learners are visual learners."

  "Interactive video – will be invaluable to organize reports, topics and information."

  "Interactive video disk – allows for teacher control of classroom materials, order, pace, review, etc."

  "Video disk CD ROM extremely large storage capability – versatility; fast access."

Video disk technology was cited as an excellent information resource, providing students access to data bases. The video output presents information to students in an interesting and exciting manner.

Interactive video disks offer students a resource they can use at their own pace for general information and research projects.

- Video Cassette Recorders were the third ranked most promising educational technology, cited by 18 percent of respondents. Typical comments include:

  "Computers and video cassette/television units: versatile, cost-accessible to most schools, powerful."

  "Probably the VCR and purchased and taped from TV programs."

  "VCRs are proving to be very beneficial in helping."

  "VCR – inexpensive, quick access to information."

  "VCR – staff comfortable using this equipment."

  "Video cassette recorders with television, our usage has continued to grow."

  "Video cassette recorder – our teachers find it inexpensive and simple."

  "VCRs – there is a wealth of material available at nominal prices in all subject areas."

  "VCR and interactive video disk. Flexible, integrated media."

  "VCR & TV because it allows for flexible scheduling."

  "Video cassette recorder – has replaced the 16mm projector and is easier for student and teachers to use."

  "Video – enhanced core curriculum and instruction brings culture not otherwise available."

  "Video recorders – our district is converting 16mm to video computers – this is the future."

  "VCR – for enhancing curriculum and playing student-made videos."

  "Tapes have more instructional information – a picture is worth a 1000 words."

  "VCR!! so much is available on VCR tape now. It could be a tool in any class."

The video recorder is replacing 16mm projectors and slides in classrooms. Teachers state that they are easy for both students and teachers to use. Several mentioned that easy use is due to VCRs in the home.

Another reported VCR value is the large amount of programming available. "It could be a tool in any class." Flexibility is another benefit. Teachers can use VCRs whenever appropriate.

Two very important points also cited were economics and educational value of video. Teachers perceive VCRs and video materials as "cost-accessible to most schools."

"A picture is worth 1000 words." VCRs provide a high-quality educational resource. Schools record programs from public broadcasting and other channels to use at the most appropriate time. Camcorders offer the opportunity for students to produce programs for class showings.

- Telecommunications received the fourth largest number of most promising citations with 11 percent. Teacher comments include:

  "Computer networks and telecommunications: they offer a chance to bring the real world to students."

  "Network and telecommunications – all disciplines can benefit from global communication. Administration office can communicate with colleagues."

  "Telecommunications – opens the door to the newer computer world."

  "Telecommunications to outside "expert" systems, e.g. data bases."

  "Telecommunications would be of great value if we could afford it."

  "Telecommunications – brings courses to your school from on-site locations."

  "Telecommunications – including access to affordable networks within data bases."

  "Telecommunications – our geographic isolation can be lessened by this technology."

  "Telecommunications – exposes our students to other students their own age but different economically."

  "Telecommunications – for students to communicate with 'pen pals'; data base searching."

  "Telecommunications – also brings courses not available locally."

  "Telecommunications, because it allows us to expand our world."

  "Telecommunications ranks high because of the unlimited potential."

Some view telecommunications in a broad perspective, including data and video. A number of respondents specifically mentioned remote distance learning as a video application.

Respondents commented that telecommunications brings the "real world to students." Data bases are available through telecommunications. Also, students use telecommunications to communicate with other students. Several respondents used "affordable" as a comment.

- Overhead Projectors were listed as most promising by 9 percent of respondents. Typical teacher comments:

  "Our teachers still like the old overhead for everyday use."

  "Overhead projectors – because teachers are familiar with them and know how to use them well."

  "Overhead projector – allows large groups to see clearly."

  "Overhead projector interfaced to a computer allows teachers to demonstrate and use software as a medium."

"Overhead projectors – for providing a visual image during group discussion."

"Overhead – it is more functional because of the computer projection devices."

"Overhead – cheap, effective, and easy to use."

"Overhead, video cassette, personal computer – they're readily accessible, low cost, instructional tools."

"Overhead projectors – can use with large groups; focus attention better."

"Overhead projector – some teachers are chained to their projector."

"Overhead projectors because of versatility."

This older technology is widely accepted since respondents ranked usage 3.48 on Question 1. Overhead projectors were ranked second in use and value behind microcomputers.

Teachers cited ease of use, versatility, and good visual image for large groups as positive features. Low cost was also mentioned. Course materials on transparencies are easily produced on copy machines.

Interface devices, another newer technology, allow computer output to be directly projected on overhead projectors. Since the screen used by overhead projectors may be large, this form of computer output permits classes of students to view a computer screen.

- Computer Networks ranked sixth at 7 percent. Comments by teachers include:

"Computers networked between our lab to the classroom."

"Computer networks - exchange of information and transmission of knowledge quickly."

"Networked computer labs. Local area library network."

"PCs and computer networks offer students more information with easy access."

"Computers in a networked situation. Greatest benefit and makes expense worthwhile."

"Network computers – ease of use and programs and equipment."

"Networking for its convenience."

"Networked microcomputers give large numbers of students access to many programs."

"Computer networks – communications and immediate feedback to accelerate learning."

"Networking/classroom management allows me to do something while students watch."

"Typing management – networking – cut down on disk usage and damage."

"The computer network system is the most valuable tool for teaching, reinforcement and enrichment."

Benefits cited are rapid information access, immediate feedback, extensive programming availability and library resources.

Networks were rated only 2.14 in usage in Question 4 but the value rating and ranking on this question indicate that computer networks are an emerging technology.

- Television/Cable TV tied for seventh with 6 percent. Although one of the older technologies, teachers see value especially with the newer technologies of video recorders and computers.

  "Of the items listed above which we can afford, I'd say television/cable TV holds this priority."

  "TV/VCR seems to be most promising for our use – varied subjects being produced, ease of use."

  "TV/video in any of the various formats. Fits easily into the existing culture/tasks/ expectations."

  "Television – we've just begun to incorporate TV beyond the usual. We have purchased editing equipment."

  "VCR & TV: It's easily available at a relatively low cost and easy for most teachers to use."

  "Cable TV and video cassette recorders can be shared with entire class."

  "Television and video because it is cheaper to use and more students benefit."

  "TV and video programs as well as telecommunications systems provide the visuals needed for students' understanding."

Major values include low cost, ease of use, increasing educational materials, and newer forms of delivery such as satellite, cable, and lifelong learning networks.

- Computer-Assisted Instruction was also tied for seventh in the number of citations by respondents.

  "CAI will continue to be the most promising usage because of budget priorities."

  "CAI – ease of use and teacher familiarity."

  "CAI and software to aid in problem solving – when teachers individualize and prescribe, take more responsibility."

  "CAI — as more students become computer literate, they are able to accept more information from computers."

  "CAI – convenient, educational activity of value and motivates students."

  "CAI – computer is patient."

  "Computer-assisted instruction because students will have access to teacher instruction."

  "CAI – frees the teacher to teach."

Teachers claim CAI is a good adjunct to instruction providing ease of use, teacher familiarity, convenience, motivation and patience.

- Desktop Publishing was also ranked in a tie for seventh. Schools use desktop publishing for student and teacher projects/publications.

  "Desktop publishing – many applications, saves money."

  "Desktop publishing – cost savings, professional appearance."

  "Desktop publishing creates a motivational tool to be used for students' writing."

  "Desktop publishing – written word of the future."

  "Desktop publishing – creative tool for students and staff."

This technology resource offers a low cost method of producing papers, presentations and publications.

- Multimedia Computer Projection System was listed by 5 percent of respondents. This is significant because the 1.78 usage reported in Table 1 is low.

  "Multimedia – integrates text, graphics sound and video."

  "Multimedia computer projection system will be valuable in future for teaching class."

  "Multimedia technology computers, laser disks, video cameras – the combination of these offer many opportunities."

  "Multimedia computer projection systems – they empower teachers, the most important link in the educational delivery system."

Driven by computers using video disk or broadband telecommunications, multimedia permits students to view graphics, text, video as well as hear about the subject.

Least Promising Educational Tools

The third question asked was, "Which of all the educational technology tools do you consider the LEAST promising for continued usage?" Only 54% of the total number of tools were cited as least promising compared to most promising in Question 2.

Table 5 (page 20) lists least promising tools in order of number of references, together with percent of total respondents naming the tool.

It is interesting to note that microcomputers were not listed at all. The following also received a small number of citations:

Software to Aid in Problem Solving	1
Computer-Aided Design	1
Desktop Publishing	2
Off-Site Information Services	2
Courseware	3
Computer Networks	3

Least Promising Education Tools for Continued Usage

Table 5

	Percent of Respondents
Projection systems (movies, slides)	33
Audio tapes or compact disks	8
Robots	7
CAI - Computer-Assisted Instruction	5
Mini/large computers	4
Voice recognition unit	4
Television/cable TV	4
Remote distance learning	3
CMI - Computer-Managed Instruction	2
Others rated less than 2%	

- Projection Systems including 16mm film, slides and film strips were listed substantially more often than other technologies as the least promising.

  "16mm is the least promising – video is simply superior. VCR materials are less expensive."

  "Movies and slides, VCR equipment easier to use; sound quality superior."

  "16mm film – cumbersome and expensive."

  "16mm film – expensive and sound of projector running d. .racts."

  "16mm – films too expensive, more easily damaged than video cassette "

  "16mm movies and slides. Being replaced by video – less expensive and less cumbersome."

  "16mm films – being phased out of media libraries."

  "Filmstrips will most likely disappear from the educational scene."

  "Movies, slides, replace with interactive video."

Projections systems are more expensive and less flexible than video recorders. Teachers look upon projection systems as old/obsolete technology.

- Audio Tapes/Compact Disks were the next technology respondents rated as least promising.

  "Audio tapes – most students are visual learners."

  "Audio tapes are not used much at our school. Most students relate best to audio-visual presentation."

  "Audio tape – do not seem to fulfill student needs of personalization and sustained attention."

  "Audio tapes – poorer quality, hard to access."

  "Audio tapes – simply antiquated."

  "Audio tapes – students don't concentrate when just listening."

  "Audio tapes – today's students are too used to visual stimulation to just sit and listen. (A pity!)"

  "Tapes – no one wants to listen anymore."

The major negatives mentioned were that students want visual stimulation, and audio does not sustain their attention.

- Robots were rated the third least promising technology.

  "Robots in education – great for industry, limited application in education."

"Robots – expensive, impersonal, would not seem to match any of our instructional objectives."

"Robots – what would you use them for?"

"Robots – too expensive and limited use for the amount of money spent."

"Robots – I believe their cost will prohibit them from being widely used."

"Robots – we just have no need for them."

"Robots seem of little interest to students at this particular institution."

Limited use and high cost were major detriments reported.

- Computer-Assisted Instruction is rated next in least promising rankings. It is interesting to note that CAI was rated most promising by approximately the same percentage of respondents.

"CAI – not flexible."

"CAI – the software is not of the best quality."

"CAI – students using remedial programs are bored."

"CAI – limited use in problem solving and limited motivational device."

"CAI – good for drill and practice but teacher pupil interaction is needed for learning."

"CAI boring."

"CAI – the students become bored. It is only feasible for a limited number of students and lower IQs."

CAI is considered boring and of limited use in "least promising" responses.

- Mini/Large Computers are reported to be too expensive and replaced by microcomputers.

"Large computers – too expensive."

"Large integrated learning systems – too expensive, lack of personal contact, need to challenge skills."

"Mini/large computers – the price at this time is too expensive for us."

"Mini/large computers – not practical or cost efficient in school setting."

"Mini/large computers – unnecessary and too expensive."

"Mini/large computers – with the increased power, speed and availability of micros."

"Mini/large computers – micros are becoming more and more powerful."

- Voice Recognition Units have limited applications that have not been extensively developed or promoted.

  "Voice recognition unit/voice messaging – this technology hasn't reached our system."

  "Voice recognition unit is basically helpful and useful for teaching of the blind."

  "Voice recognition unit – don't see any need."

  "Voice recognition unit – I can't think of any application that would make it useful in our situation."

- Television/Cable TV was rated least promising by 4 percent and most promising by 6 percent. Size of screen and the taping/previewing requirements were stated as negatives.

  "19 inch TV screen too small for classroom teaching."

  "Cable TV films. You can't get what you want when you want it."

  "Cable TV is not interactive and requires pretaping and previewing."

  "Television – it is a passive learning tool and not an interactive one."

  "Television/cable: lack of offerings to fit curriculum."

- Remote Distance Learning was cited by 3 percent of the respondents as least promising. Comments included impersonal and frustrating for students.

  "Remote distance learning – I feel that taped VCR lessons and computer networks are more valuable."

  "Remote distance learning – too impersonal."

  "Remote distance learning – the impersonal nature of the instruction."

  "Remote distant learning is frustrating for students."

  "RDL – the need to incorporate two-way video as well as voice."

- Computer-Managed Instruction is the last significantly rated technology as least promising.

  "CMI – students being 'managed' by a computer rather than learn on their own."

  "Computer-managed instruction is doomed: it doesn't give the needed human feedback and analysis that you need."

  "Computer-managed instruction – teachers are not trained how to use this."

  "CMI – because we do not have the equipment and the teachers do not seem to be motivated."

  "CMI – has not been well received by our students."

  "CMI – students always seem to dislike this after a while."

Technology Use in Curricula

Survey Question 4 asked, "In which SUBJECT AREAS is educational technology used in your school?" A scale from 1 to 4 for amount of usage was also included.

Table 6 (page 25) summarizes the percent of total respondents, listing the use of a specific technology for each subject area. Average usage rating for each course and average percent usage per course are also presented.

Video cassette recorders were used 2 percent or more of schools surveyed in every one of the 11 courses. Listed for 10 of 11 courses were microcomputers, overhead projectors and projection systems. After these four technologies, the remaining were sparsely used, averaging 2 percent or less per class.

Consistent with results in Questions 1 and 2, micro/personal computers had the highest average percent usage (16%). Leading course usage is 48 percent in computer sciences; 28 percent in mathematics and English; 18 percent in physical sciences and 16 percent in social sciences.

Overhead projectors, projection systems and video cassette recorders had average class usage of 9 percent. Overheads were reported to be used 22 percent in mathematics. Video recorders and projection systems were most used in social studies.

Courseware (10%) and audio tapes (8%) were rated highly in foreign languages.

The following technologies were listed less than 1 percent for each of the 11 subject areas:

Off-site information services
CAD - Computer-Aided Design
Multimedia projection system
Integrated learning systems
Robot
Remote distance learning
Voice messaging
Voice recognition unit

The following technologies were listed at more than 1 percent for only one subject area:

Desktop publishing	4%	English
Test correction scanners	2%	Mathematics
Computer networks	4%	Computer Sciences
Computer-Managed Instruction	3%	Computer Sciences
Telecommunications	2%	Computer Sciences
Mini/large computers	2%	Mathematics

These results are consistent with low usage reported in Question 1 except for desktop publishing which had a relatively high (2.54) usage rating. This technology may be used by teachers for overall support of school and classroom publications.

Courses which use educational technology the most are listed in descending order in Table 6. The usage rating is the sum of each technology percentage divided by 24 technologies. Courses which use technology the most are:

Computer Sciences	3.5%
English	3.1%
Mathematics	2.9%
Social Studies	2.9%
Natural Sciences	2.8%
Physical Sciences	2.7%
Environmental Sciences	2.6%

Technology – Course Linkage

Table 6

	Average Percent Usage	Computer Sciences	English	Math	Social Studies	Natural Sciences	Physical Sciences	Environmental Sciences	Fine Arts	Foreign Languages	Visual Arts	Physical Education
Micro/personal computers	16	48	28	28	16	10	18	2	3	12	7	6
Overhead projector	9	12	14	22	14	8	11		2	8	6	3
Video cassette recorder	9	6	14	4	17	13	12	2	3	8	8	11
Projection systems	9	6	13	6	20	15	13	2	4		13	8
Television/cable TV	2	2	4		6	4	3			3	3	2
CAI - Computer-Assisted Instruction	2	2	3	5	2		2			3		
Software to aid problem solving	1	2		4								
Courseware, e.g. math, science, English	1			2	2					10		
Audio tapes or compact disks	1		4		2					8		2
Video disk/compact disks	1				2	4	4					
Desktop publishing	0		4									
Test correction scanners	0			2								
Computer networks	0	4										
CMI - Computer-Managed Instruction	0	3										
Telecommunications	0	2										
Mini/large computers	0			2								
Usage Rating		3.5	3.1	2.9	2.9	2.8	2.7	2.6	2.2	2.1	2.1	1.9

How Can Companies Help?

In response to open-end Question 5, teacher comments were quite consistent with prior questions as summarized in Table 7 (page 27).

The overwhelming issue is money, with 45 percent of respondents citing various money-related issues. Lower equipment, telecommunications and on-line prices were stated by 23 percent. The second money category (18 percent) sought grants, subsidies and equipment gifts. License fees and lab pacs amounted to 4 percent.

"Continue to improve technology to make it more user friendly and lower in cost."

"Cost is the greatest barrier for our school."

"First, cost. Secondly, incompatibility with telephone systems for telecommunications hardware."

"Help keep costs down, encourage districts to write grants for prototype study – help us set up demonstrations."

"Improve compatibility and give better price breaks with trade-in deals on outmoded equipment."

"Lower cost and create easier access to telecommunications."

"Lower cost – inform users on new applications."

"Lower cost to schools. When hardware and software become cheap, teachers will use them."

"Lower prices, partnerships with school districts for demonstration projects."

"Price – make it affordable. Educational budgets are not those of corporations!"

"The prices have to be lower before small schools can afford the new technologies."

"Decrease cost to make hardware and service more readily available."

"Lower price of hardware and telecommunications (on-line time)."

"Make equipment, software, services available at much more reasonable prices – especially updates!"

"Our major need is access to hardware and/or ability to convince governing bodies of the need to fund equipment purchases."

"Our major problem is lack of funding to acquire hardware and software. We need help to convince the public."

"Reduce costs to schools for hardware, software and on-line communication time."

"We don't have enough money to purchase the wonderful equipment and programs I've seen."

"The biggest roadblock to expand use of technology is that it's too expensive and high tech equipment is intimidating."

How Can Companies Help?

Table 7

	Percent of Respondents
Financial - Total	45
Lower Price	13
Lower Telecom/On-line Prices	10
Money for Equipment	7
Money – general	6
Money for grants, work study, etc.	5
License fees and Lab packs	4
Teacher Training	15
Improve Product	13
Provide Support	8
Listen to Teachers	4

Telecommunications is the only technology where there is direct cost associated with usage. Even though all technologies have a depreciation cost, it is not as apparent as out-of-pocket monthly cost. Overall, 10 percent of the respondents indicated concern for telecommunication and information services costs.

"Free access."

"Giving students and teachers reasonably priced access to on-line time & data resources."

"Make telecommunications and networking more reasonably priced and friendly."

"Make the cost of networking during educators' hours inexpensive."

"More projects like KIDNET with a lesser cost would help tremendously."

"Provide access to E-Mail and other services by allowing schools to pay a flat fee."

"Provide off-site information services at a very low rate."

"Reduce subscription rates and on-line time charges to school libraries."

"Telecommunications – currently too expensive."

"The #1 problem with telecommunications is the on-line cost. Far too much for our school to afford."

"We would like to subscribe to an on-line data base service but costs are too high."

"By making telecommunication services affordable – 800 numbers, etc."

"Make connections for rural schools more affordable."

"Make telecommunications and networking more reasonably priced and friendly."

"Make the cost of networking during educators' hours inexpensive."

Teachers were concerned about software licensing policies including site agreements, multiple copies, networking, copy protection and costs.

"Allow multiple copies of computer programs to be made or reduce cost of multiple lab packs."

"Cheaper – better group purchases, more site licenses, fewer restrictions."

"Encourage elimination of copy protection, allowing backup copies to be made."

"Free use of duplicating once original purchased."

"Lower cost!!! Multiple use licenses with programs. Inclusive backup copies. Networking licenses."

Teachers' next highest ranked request is training (15 percent) and support (8 percent).

"Work with students in colleges. My experience is that teachers teach as they were taught."

"Assist in teacher training."

"Business/School partnerships – finances, field trips, training for teachers in business industry."

"Come into the schools and conduct hands-on workshops for faculty, to inspire teaching with technology."

"Educate teachers in learning how to use new technology."

"Help the schools buy the equipment and teach the teachers how to use it."

"Offer more training. Perhaps internships for teachers to become 'teachers of other teachers'."

"Problem is not computers and telecommunications, it is time to train faculty."

"Provide conferences and seminars to keep educators informed."

"Provide hands-on workshops. Give us simple how-to steps to use, then we can grow and expand."

"Provide in-service for teachers. A valuable service is a hotline to answer questions."

"Provide, encourage, train teachers to use technology available. Teachers have built-up fear about technology."

"Teachers seem to be afraid of technology and need guidance in learning how to use it."

"Train teachers! The students catch on very quickly but few teachers do."

"We need training; our administration needs educating, our risk-takers need time, resources and go-ahead."

The need for a wide variety of product improvements was stated by 13 percent of respondents.

"Clearer manuals, simple descriptions, suggestions of practical set-ups."

"Create more simulation type of programs – no more drills."

"Develop a lap sized cheap unit for use at a student's desk."

"Giving teachers lesson plans, support materials and everything they need."

"Hardware that will run different types of operating systems."

"Information service complete with lessons, plans and possibly tests available for teacher usage."

"Keep the writing of instructional materials away from the technical writers."

"Long distance learning; put students in touch with outside resources; information services."

"Manuals accompanying equipment and programs are often very difficult to use. They aren't organized well."

"Simplify! Instruction manuals 3 inches thick are daunting! Make it as 'user friendly' as possible."

"Telecommunications should be easier to use and load information."

"The development of tutorials to be self-contained so they address the individual students' learning."

"To supplement a physics teacher, develop a computer-managed course complete with information and testing."

"User friendly equipment needed. Help with applications."

"Video systems for classrooms – multiple large monitors is a good option."

"Design products (software and hardware) that are intuitive and intelligent."

"Design software for higher order thinking skills; lower price for lab sets."

"Design system package that would fit into curriculum demands at an affordable cost to schools."

"Don't forget that most of your users have the old equipment and stop promoting the new. Promote all."

"Produce good quality materials that key into the basic needs of students."

"Programs promoting higher level thinking skills, make available computer programs that are copyable."

"Work together to resolve hardware & software incompatibilities. Make products easier to install."

"Work with book publishers to incorporate books with computers."

"More and better network software."

Interestingly, 4 percent of teachers said they should be consulted in developing products and supporting schools.

"Ask educators to become more actively involved in the pre-production process of ED software."

"Use classroom teachers in the development of technological products so that these tools may impact directly upon instructions."

"Consult educators for what information should be included in the program. Keep it user friendly."

"Consult experienced classroom teachers."

"Consultation with teachers about what their needs are and what is most effective with students."

"Develop programs with teachers to fit individual school needs."

"Have teachers in the planning. Make programs to which teachers can add their own vocabulary information."

"Speak to faculty members using the material to access their needs and interests."

"Talk to teachers and listen. These resources need to be useful in our world."

"Utilize teachers as resources, consultants so software follows proven education principles for level."

What Do Teachers Need?

In the aggregate, teachers responded to Question 6 primarily in two categories: professional and financial resources. Table 8 (page 33) summarizes subcategories under the two major needs.

The highest demand in professional resources is training. Teachers listed many different types of training and education. Universities should include technology in undergraduate education curricula so future teachers are technologically competent. On-site training was suggested. Help in training and motivating teachers was also mentioned.

"Hands-on workshops, cheaper costs for equipment. We are so limited by time. Our day is too short."

"Additional training and sharing with other workshops, visits to other centers for ideas."

"Allowing me to teach teachers during the day, not after school."

"Availability of modern resources; an on-site expert and training of all personnel."

"Colleges should teach students new technologies – student teachers have not been exposed properly."

"Companies or universities should provide low cost training to faculty – inspire them about new technologies."

"Cost is a primary factor in New York State. Teacher training has been slow and costly."

"Easy videos or training tools to help teachers learn to use resources."

"Educational representatives who could provide in-servicing to teachers."

"Higher quality materials to demonstrate to reluctant teachers."

"Incorporate instruction into new teachers' undergraduate work and provide in-service for veteran teachers."

"Increased technology in-service for all teachers, not just the few who are very interested."

"More training – it is impossible to read a manual, learn a software program like desk-top publishing."

"Provide inexpensive training locally."

Time was the second highest resource cited. Time is needed for training, new technology awareness, teaching other teachers, and to implement.

"More time off for training and in-service."

"More time to learn what is new."

"More time to plan and implement."

"More time to understand the equipment and the software would help."

"More time!"

"Time and money to train myself and others in what is available."

"Time for me to prepare and teach sessions on specific applications to classroom teachers."

"Time – more time is needed for me to study the technology available and get the pertinent information to others."

"Time to learn how to best use what is new."

"Time to learn myself – I'm overloaded just trying to keep up!"

"Time to learn. Money to buy. Space to store."

"Time to study how to use new equipment and software."

"Time to train faculty in the use of new materials and equipment."

"We have great teachers and administration support, funds are a problem, but time is a BIG handicap."

What Do Teachers Need?

Table 8

Professional Resources		62%
Training	27	
More Time	12	
More Computers	7	
Software Quality	5	
Support	5	
Availability of Demonstrations	4	
More Resources	2	
Financial Resources		32%
Money (Hardware)	12	
Money (General)	10	
Lower Prices	7	
Money (Grants, Work-Study)	3	

Teachers sought more hardware, principally computers. Many respondents just said "more equipment." Representative comments include:

> "Have more microcomputers in classrooms and allow teacher access to micros for home use."
>
> "Having more computers in each school to lower the student/computer ratio."
>
> "I bring curriculum areas into computer classes but no machines available to go into department."
>
> "More equipment and more staff to be able to teach the teachers in usage of technology in the classroom."
>
> "More equipment, realistic funding of education, financial reasons for increasing my skills."
>
> "The availability of sufficient microcomputers."
>
> "Funding for more equipment and more staff to reduce my daily menial tasks."
>
> "Have more microcomputers in classrooms and allow teachers access to micros for home use."

Software quality was an issue expressed by 5 percent of respondents.

> "Better instruction manuals with software."
>
> "Better software programs – produced/written by teachers – not Hollywood productions."
>
> "Good tutorial software with interactive capability to help a student having difficulty."
>
> "Make software adapt to teacher methods rather than vice versa. Include teachers more in software."
>
> "More and better learning simulations."
>
> "More quality Computer-Assisted Instruction software."
>
> "Software and interactive disks that allow me to integrate the technology into the classroom."
>
> "Software matched and correlated to my textbook."
>
> "Software more easily managed and self-learned."

Support, demonstrations and other general resources were additional needs mentioned.

> "A full-time computer coordinator for the school district with lots of elementary educational experience."
>
> "A hot line for help for all the technology we have."
>
> "A more accepting and knowledgeable community."

"A more informed administration; fiscal support and training for staff."

"Additional clerical help to free me up from the day-to-day running of the library."

"Assist in educating the public, who pay taxes for education, on the importance of sufficient budgets."

"I see the need for a full-time person in the technical field to coordinate use of technology."

"More administrative support for technology."

"More personnel and more scheduled time to work with a computer system for our media center."

"More support from the developers in the use and maintenance of the equipment."

"Person to facilitate use."

Nearly one third of the respondents suggested that financial resources were needed in the form of more money for hardware and other purposes, lower prices and special areas of grants, capability development. Typical comments include:

"Lower costs so that small schools can attain some of the wonderful things that are available."

"Lower costs would certainly improve our use."

"Lower costs! Educate general public about the need for more educational technology so they will support it."

"Cost is a primary factor in New York State. Teacher training has been slow and costly."

"Lower prices, or money to purchase more equipment. Need support from administrators."

"Lower the cost instead of added features."

"More affordable software and hardware."

"Reasonable pricing, time to explore uses."

"Reduce costs, add staff, create time to prepare."

"Wishful thinking – keep costs as low as possible."

"Funds – federal and state support."

"Grants to provide money for teacher training in technology and to acquire up-to-date equipment."

"Grants to purchase equipment."

"Information concerning grants available for more equipment."

"Money! To supply needed equipment, software, and teacher training."

"Money. Let us know of any grant money that might be available."

"More money to spend on technology, software and time to teach teachers to use it."

"School budgets are tight and we need to look for outside funding."

Conclusions

This study elicited valuable, thoughtful responses from teachers considered technically knowledgeable. A substantial willingness to communicate was witnessed by the 14 percent response to an extensive nonincentive survey by an organization unknown to K-12 teachers.

This section attempts to distill the information learned and suggest promising initiatives. Readers may draw their own conclusions and suggest other directions.

Educational technology has excellent potential, especially with video, data, sound and networking making the learning experience an exciting adventure.

Technology

The study examined teacher attitudes about technology in a variety of ways. Usage and value data were acquired and correlated to specific subject usage. Open-end questions sought the most and least promising technologies.

A summary of key technology trends is shown in Table 9 (page 37). Of traditional technologies, microcomputers and related software and video recorders had growth-oriented response. Traditional television was considered of lower value.

Emerging technologies show computer networks, telecommunications and information services, and desktop publishing as having higher value.

Video disk and multimedia interactive projection systems were the most promising newer technologies.

Another way of grouping technologies rated higher value is according to the three information systems functions: input, handling and display. Table 10 (page 38) presents such a summary.

Respondents indicate that valuable inputs are software, telecommunications/information services, video recorders and video disks.

Information handling is accomplished by microcomputers/software, computer networks and desktop publishing. The latter could very well be considered a total information system.

Electronic technology usage and value in the future will increasingly depend on the availability of software for programs, data, video and audio. Students must be able to easily access and use as they now use books.

Display consists of overhead projectors (including computer-driven), television monitors and multimedia projection.

In summary, the teachers foresee as high potential future value interactive multimedia – video, data, sound – systems providing educational resources on demand.

Key Technology Trends

Table 9

Traditional	*Emerging*	*New*
Projection Systems ⇩	Robotics ⇩	Video Disk ⇧
Audio Tapes ⇩	Computer Networks ⇧	Multimedia Projection ⇧
Television ⇨	Telecommunications ⇧	Voice Messaging ⇨
Video Recorder ⇧	Info. Services ⇧	Voice Recognition ⇩
Overhead Projectors ⇨	Desktop Publishing ⇧	
Microcomputers ⇧		
Software ⇧		
Mini/Large Computers ⇩		

⇧ **Higher Value** ⇨ **Medium Value** ⇩ **Lower Value**

Educational Information System

Table 10

Input	*Handling*	*Display*
Software	Microcomputers	Overhead Projection
Telecommunications	Software	Television
Info. Services	Computer Networks	Multimedia Projection
Video Recorder	Desktop Publishing	
Video Disk		

Trend: Multimedia – video, data, sound – systems providing educational information on demand.

Teacher Needs

By examining responses to teacher needs expressed in open-end Questions 5 and 6, the categories shown in Table 11 (page 40) were most frequently cited. Percentages shown are the average combined responses to both questions.

Table 12 (page 40) presents response to Question 5 on how computer and telecommunication companies can help make educational technology a more valuable resource in educating students.

Teachers are appealing first for financial help, whether it be lower purchase or operating prices, equipment discounts or donations, grants and many other ideas.

Secondly, teachers are requesting training and support of lead school technology coordinators, teachers themselves and future teachers.

Teachers are seeking better products. They suggest involving teachers in product design. Their comments should guide industry to view product in the broad definition including the device, human interfaces, manuals, training, maintenance, support and a dedication to effective usage.

Teachers also requested more time for self-training, planning, implementing, studying technology and teacher training.

Although the question was not asked, the open-end comments suggest that educational technology is a part-time preoccupation for many teacher/learning coordinators/librarians who have full-time educational assignments.

Considering the emphasis on financial needs, it is interesting to compare the cost of educational technologies considered valuable by teachers. Figure 1 (page 41) shows the main technologies cited in this study positioned on a value-cost grid.

Current widely used educational technologies shown in bold tend to be lower cost. Video recorders, overhead projectors, projection systems and television each cost less than $1,000 per classroom.

Future educational technologies including more advanced microcomputers (workstations), computer networks, telecommunication/information services, video disks and multimedia projection systems have much higher relative cost as shown in Figure 2 (page 42).

Therefore, there is a major potential problem in deploying valuable new educational technologies in the reported difficult economic climate.

Teacher Needs

Table 11

Financial Resources	42%
Support and Training	31%
Improved Product	11%
More Time	6%

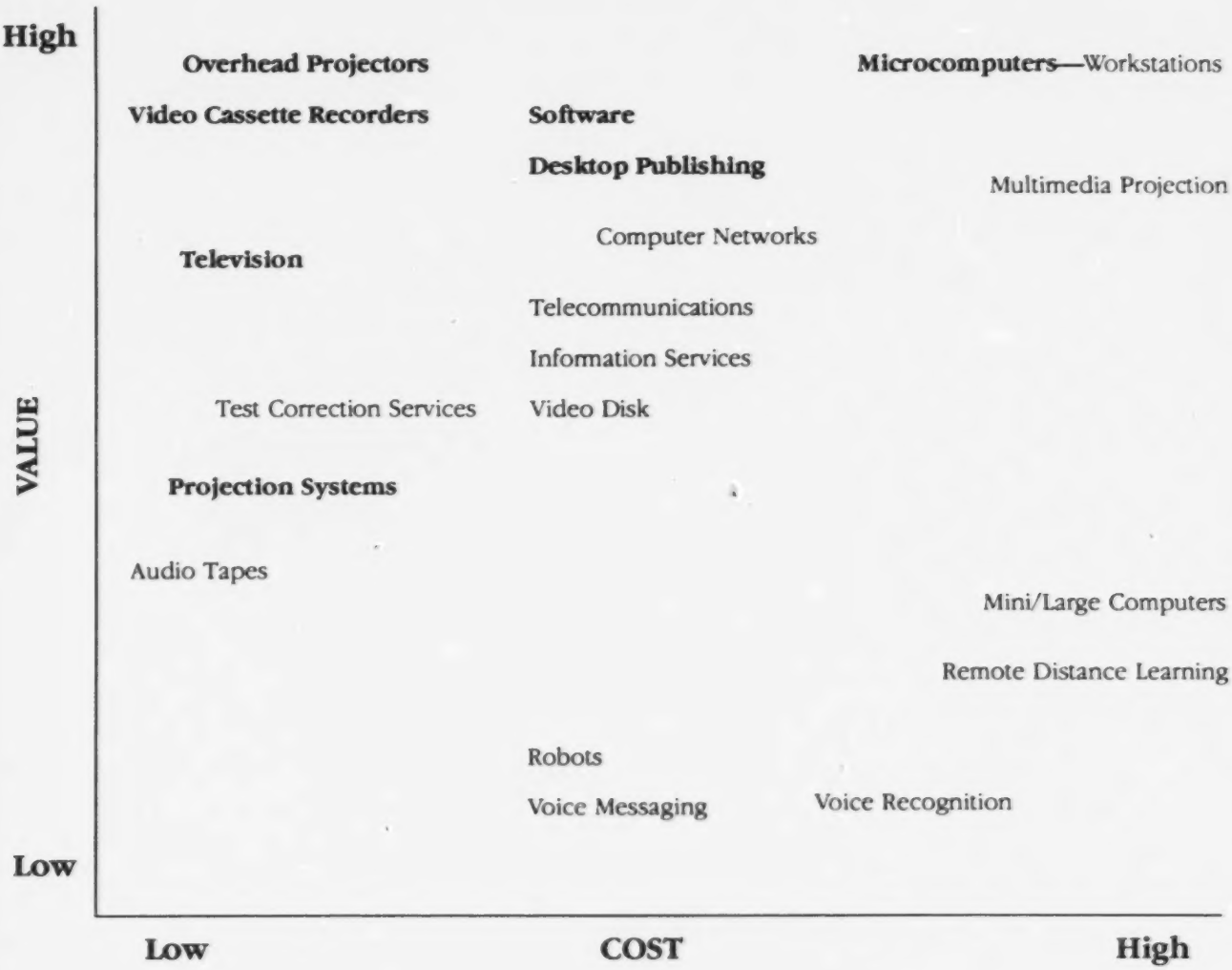
How Telecommunications and Computer Companies Can Help Make Educational Technology a More Valuable Resource in Educating Students

Table 12

Financial Resources	45%
Support and Training	23%
Improved Product	17%

Figure 1

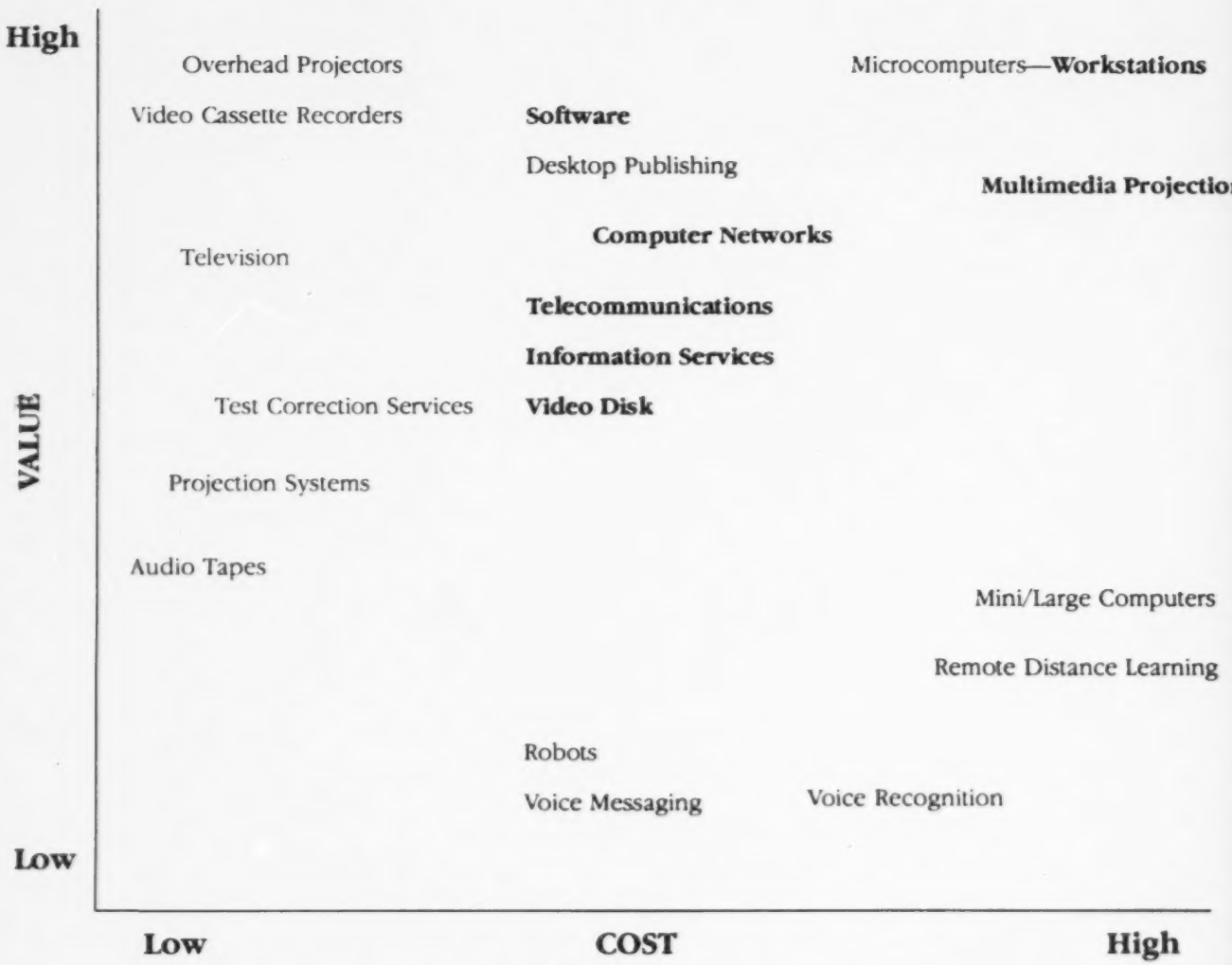
Educational Technology Value-Cost Relationships –
Current Usage in Bold



47

Figure 2

Educational Technology Value-Cost Relationships –
Future Interest in Bold



Telecommunication and Computer Company Roles

The K-12 economic problem is real and a substantial detriment to realizing the value that educational technology can bring to U.S. schools.

Companies should work with school organizations and local, state and federal government to help define models of educational technologies needed. In addition to product, usage models must address operational support and resources. From these models, plans for effective implementation of future educational technology may be developed.

The second step is helping school authorities sell the need and value of educational technology to decision-making public and governmental bodies.

Third, cost-effective products should be developed to provide excellent value within limited school budgets. Issues such as competitive product interconnectivity may require cooperation between companies.

Regarding teachers stated need for more support, companies must commit to adequately support the educational system. Demonstrations, workshops, seminars and conferences are only the start.

Companies may consider developing partnerships in support. Possibly, educational resource materials could be jointly prepared. Local universities, school district administrations or other groups might effectively train school personnel using these materials.

The partnerships in support may well consider providing lead educational technology teachers with training materials for teachers.

Companies should encourage teacher colleges to provide courses in educational technology, and encourage undergraduate students to use the latest products so they become comfortable employing these resources in their future classrooms.

The third category is improved product. Teachers suggested that companies listen to and use experienced teachers to help specify and design products. Educational technology must be integrated into curricula so compatibility with textbooks and other resources is seamless.

Companies must also consider evolving the embedded educational technology base. How can current microcomputers be upgraded into networks and multimedia? How can new applications software work with today's computers as well as the next generation? How can telecommunications and computer networks link into current environments?

The total product concept must be the goal of every company. The device (microcomputer, VCR, video disk player) is only a small part of the overall product.

Teachers must be adequately informed and trained to effectively choose, implement and maintain educational technology products. Designs must consider usage by technically illiterate teachers who are reluctant users. Manuals, software, videotapes, local workshops, whatever it takes to make teachers successful users, should be the suppliers' goal.

Corporations must have the dedication and zeal to insure that educational technology is integrated into the fabric of the school system. It must be used as easily as textbooks, notepads and pencils.

Only through such commitments will educational technology's potential to improve students' learning environment be achieved.

Appendix

Questionnaire and Cover Letter

NATIONAL ENGINEERING CONSORTIUM

EDUCATIONAL TECHNOLOGY USAGE AND EFFECTIVENESS STUDY

We are conducting a study on the use of technology in K-12 education. Please help us by completing this questionnaire. If you check below, we will send you the results of the study. Be sure to complete the name and address section.

_____ Please send me the results.

The following is a list of educational technology tools that might be used in your school. Please tell us how much you **use** them, your estimate of their **value** and the educational applications for which they are being used.

Usage Rating

1 - Not used
2 - Used seldom
3 - Used often
4 - Used a great deal

Value Rating

1 - Not valuable
2 - Slightly valuable
3 - Valuable
4 - Extremely valuable

1. Educational Technology Tools	Usage	Value	Educational Applications
a) Overhead projector	1 2 3 4	1 2 3 4	_____
b) Projection systems (movies, slides)	1 2 3 4	1 2 3 4	_____
c) Multimedia computer projection systems	1 2 3 4	1 2 3 4	_____
d) Television/cable TV	1 2 3 4	1 2 3 4	_____
e) Video cassette recorder	1 2 3 4	1 2 3 4	_____
f) Remote distance learning	1 2 3 4	1 2 3 4	_____
g) Audio tapes or compact discs	1 2 3 4	1 2 3 4	_____
h) Telecommunications	1 2 3 4	1 2 3 4	_____
i) Voice recognition unit	1 2 3 4	1 2 3 4	_____
j) Voice messaging	1 2 3 4	1 2 3 4	_____
k) Micro/personal computers	1 2 3 4	1 2 3 4	_____
l) Mini/large computers	1 2 3 4	1 2 3 4	_____
m)Computer networks	1 2 3 4	1 2 3 4	_____
n) Off-site information services	1 2 3 4	1 2 3 4	_____
o) Test correction scanners	1 2 3 4	1 2 3 4	_____
p) Videodisc/compact discs (interactive)	1 2 3 4	1 2 3 4	_____
q) Desktop publishing	1 2 3 4	1 2 3 4	_____
r) Courseware, e.g. math, science, English	1 2 3 4	1 2 3 4	_____
s) CMI - computer managed instruction	1 2 3 4	1 2 3 4	_____

Educational Technology Tools	Usage	Utility	Educational Applications
t) CAI - computer assisted instruction	1 2 3 4	1 2 3 4	_____
u) Integrated learning systems	1 2 3 4	1 2 3 4	_____
v) Software to aid in problem solving	1 2 3 4	1 2 3 4	_____
w) CAD - Computer-aided design	1 2 3 4	1 2 3 4	_____
x) Robots	1 2 3 4	1 2 3 4	_____

Any others:

y) _____	1 2 3 4	1 2 3 4	_____
z) _____	1 2 3 4	1 2 3 4	_____
aa) _____	1 2 3 4	1 2 3 4	_____
bb) _____	1 2 3 4	1 2 3 4	_____
cc) _____	1 2 3 4	1 2 3 4	_____
dd) _____	1 2 3 4	1 2 3 4	_____

2. Of all the educational technology tools listed above, which do you consider the **MOST** promising for continued usage? PLEASE LIST AND EXPLAIN WHY.

_____

_____

_____

_____

_____

3. Which of all the educational technology tools do you consider the **LEAST** promising for continued usage? PLEASE LIST AND EXPLAIN WHY.

_____

_____

_____

_____

_____

In which **subject areas** is educational technology used in your school?
PLEASE RATE EACH SUBJECT AREA FOR "USAGE" AND LIST THE TYPE OF EDUCATIONAL TECHNOLOGY USED.

Usage Rating

1 - Not used
2 - Used seldom
3 - Used often
4 - Used a great deal

4. Subject Areas	Usage	Types of Educational Technology Used
a) Computer sciences	1 2 3 4	_____
b) Environmental sciences	1 2 3 4	_____
c) Fine arts	1 2 3 4	_____
d) Natural sciences	1 2 3 4	_____
e) English	1 2 3 4	_____
f) Foreign languages	1 2 3 4	_____
g) Physical sciences	1 2 3 4	_____
h) Social studies	1 2 3 4	_____
i) Physical education	1 2 3 4	_____
j) Visual arts	1 2 3 4	_____
k) Mathematics	1 2 3 4	_____
l) Other	1 2 3 4	_____

5. From your experience, how can computer and telecommunications companies help make educational technology a more valuable resource in educating students?

_____

_____

_____

_____

_____

6. What would **help you** make educational technology a more valuable resource?

_____

_____

_____

_____

7. Your position: _____ Teacher Subjects taught _____

_____ Librarian/learning center coordinator

_____ Other _____
Please name

8. Your school: _____ Public _____ Private

9. School type: _____ Elementary (Grades 1-6)

_____ Junior High School (Grades 7-8)

_____ Senior High School (Grades 9-12)

_____ Other _____ (Grades _____)
Please name

10. The total enrollment of your school is: _____

Thank you for your professional response. Please complete the name and address section and return by **January 20, 1990** to:

National Engineering Consortium
303 E. Wacker Drive, Suite 740
Chicago, IL 60601

Name _____
First M.I. Last

Title _____

School _____

Street _____

City _____ State _____ Zip _____

Phone (_____)_____

NEC
NATIONAL
ENGINEERING
CONSORTIUM

January 3, 1990

Dear Colleague:

The National Engineering Consortium (NEC) is a university affiliated nonprofit organization that fosters a broad range of university-industry cooperative programs. The Consortium has strong ties with the telecommunications and computer industries.

NEC is presently conducting a study of K-12 educational programs using information industry technology (computers and communications). A possible outcome of this study will be recommendations for programs that will enhance K-12 schools' use of Educational Technology and Telecommunications (ETT).

The study has identified K-12 schools that are presently using ETT. As your school is one of those identified, we ask for your experience and opinions by completing the enclosed questionnaire. Results of this study will be reported to major corporations and universities.

Please return the questionnaire by January 20, 1990 and indicate if you would like a copy of the final study. Your cooperation in this endeavor is greatly appreciated.

Warmest personal regards,

Bob Janowiak

Robert M. Janowiak
Executive Director

303 East Wacker Drive ■ Suite 740 ■ Chicago, Illinois 60601
312 938-3500 ■ FAX 312 938-8787